Group housing systems for gestating sows

Survey among Belgian pig producers about the introduction of group housing systems for gestating sows[1]

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ABSTRACT: There is a global move from individual to group housing of gestating sows. In the EU, individual gestating stalls will be banned by 2013. Just like in other industrialized regions, these stalls have been the standard housing system for intensively kept sows from the 1960s onward in the Flemish region of Belgium. As the socio-economic consequences for the pig industry may be far-reaching and as farmer attitude may influence the realization of the hoped-for improvement in animal welfare in practice, we conducted a survey from 2003 until 2009 among representative samples of Flemish pig producers every 2 yr. The share of farms with group housing increased from 10.5% in 2003 to 29.8% in 2007, but then dropped to 24.6% in 2009. It appears that after 2005 users of old group housing systems in particular stopped farming. As sow herd size increased more on farms with vs. without group housing and as the proportion of the herd that was group-housed also tended to increase between 2003 to 2009, the change to group housing took place faster when expressed at the level of the sow (from 9.1% in 2003 to 34.1% in 2009) instead of farm. The percentage of farmers planning to convert to group housing within 2 yr was 4.1% in 2003, and 6 to 7% thereafter. These were typically young farmers ($P = 0.006$) with a large sow herd ($P < 0.001$) and with a likely successor ($P = 0.03$). Free access stalls were the most common group housing system (31% of farms, 37% of sows). Their popularity is expected to increase further at the expense of electronic feeding stations, ad libitum feeding, and stalls/troughs with manual feed delivery. User-satisfaction was generally high but depended on whether or not all gestating sows were kept in group ($P < 0.001$), the provisioning of environmental enrichment ($P = 0.057$), and the age ($P = 0.012$) and type ($P = 0.016$) of system. The main criteria for choosing a certain group housing system were the investment costs and sow health and welfare. The importance of economical reasons ($P = 0.007$) and type of labor ($P = 0.043$) decreased with the age of the system. In 2003 and 2005 the main reason for not

having converted to group housing was that farmers would stop keeping sows by 2013. In 2007 and 2009 it mainly concerned uncertainty about the future and maximally delaying the conversion. Belgium is one of the EU-countries where the pig industry is expected to undergo drastic changes during the few years remaining before the ban on individual housing.

Key words: feeding system, gestation stall, group housing, pig, swine, welfare

INTRODUCTION

The pig industry is moving worldwide from individual to group housing of gestating sows. Animal welfare concerns have driven this change in the US via market forces and in the EU via a legal ban on housing sows individually from 4 wk after service to 1 wk before farrowing, to be implemented fully by 2013 (EU directive 2001/88). Researchers have addressed the pros and cons of group housing (SVC, 1997; McGlone et al., 2004; Harris et al., 2006) but the opinion and experiences of pig producers have barely been documented.

As the EU-ban was expected to be a huge challenge in many member states, we monitored the transition process by surveying every 2 yr a representative sample of pig producers in Flanders, the region of 94% of Belgian pig production. Tuyttens et al. (2008) reported results of the first 2 surveys. In 2005, only 16 % of pig farms used group housing. The drastic change that the Belgian pig industry would still need to undergo justified repeating the survey in 2007 and 2009. The same methodology was used for all 4 surveys, which makes the data unique in documenting the change to group housing over 7 yr. The percentage of farmers with group housing, and those planning to convert to group housing within 2 yr, was estimated

from 2003 to 2009. As a different sample of pig producers was surveyed each time, data from 2003 to 2009 were combined for addressing the other research objectives, namely investigating (i) the type of group housing systems that are used (and planned to be built), (ii) the reasons why farmers choose a certain group housing system, (iii) the satisfaction of users of group housing systems, and (iv) the reasons why other farmers have not yet changed to group housing. Although the survey is restricted to Flanders, the situation may be comparable to other EU countries for which the ban on individual housing poses a considerable challenge, and many findings are relevant for pig producers around the world planning to convert to group housing.

MATERIALS AND METHODS

A random sample of 250, 352, 302 and 300 Flemish pig producers with at least 2 sows was selected from the national SANITEL list of all pig producers in Flanders (compiled by the Central Animal Health Association) for the 2003, 2005, 2007 and 2009 surveys, respectively. Each sample excluded farmers that had been contacted during a previous survey. In October 2002 the SANITEL record counted 9,682 pig producers, of which 5,806 had > 1 sow. Six years later, the latter number was reduced to 4,159 farmers. The questionnaire was posted to the selected pig producers. It stated that all data would be treated anonymously and the farmers were asked to fill in the questionnaire and to keep it near the phone once completed. About 1 wk later, we contacted them by telephone in order to collect the answers. If we failed to reach them, we kept on trying for the duration of 1 mo, phoning at different times of the day. The telephonic follow-up was intended to maximize the response rate. The poll-taker could also check whether the questions had been well understood and the answers made sense. Although the poll-taker was

instructed to be extremely careful not to influence the interviewee, such an effect cannot be ruled out.

The questionnaire was 4 pages long. Apart from the general data about the farm (farrow to finish farm versus breeding farm, likelihood of a successor, sow herd size) and the farmer (date of birth) on the first page, not every page had to be filled out by all farmers. Farmers housing some or all of their sows in group for at least two thirds of the gestation period were requested to fill in pages 2 and 3 about the duration that the group housing system had been operational (in yr), the average group size, whether groups were dynamic or static, whether litter was used or not, whether or not other environmental enrichment was provided, the amount of floor space per sow, and the type of group management used (1-, 2-, 3-,4- or 5-wk batch system). In dynamic groups, the group of sows are composed of sows in different stages of gestation. Consequently, the composition of the group varies frequently as sows are moved between the gestation, farrowing and insemination pens. In static groups, the group composition is rarely changed as it is composed of sows in the same gestation phase that are moved in synchrony between gestation, farrowing and insemination pens. Litter was considered to be used when a substantial amount of loose material was spread on the floor during most of the gestation period. Environmental enrichment included, as defined by the aforementioned EU-directive, any material provided to the sows for investigation, play and distraction such as straw, toys, chains, and wood. Group management systems can be organized in intervals of 1 to 5 wk in which groups of sows have the same reproductive stage such that the labor activities associated with the main reproductive stages (farrowing, weaning, insemination) are synchronized. Respondents were also asked to score their satisfaction with their group housing system concerning 8 specific aspects and in general from 1 (not at all satisfied) to 5 (very satisfied). Finally, they were asked

to indicate the type of group housing system they used on a mutually exclusive list based on 5 criteria (Table 1, see Tuyttens et al. 2008 and references therein for a description of these criteria and housing systems), for the percentage of their sows kept in group housing, and to allocate 100 points according to the relative importance of various reasons for having chosen that particular type of group housing system. On the last page of the questionnaire, the latter 3 questions were also asked to farmers who had detailed plans to change to a group housing system within a time-span of 2 yr. Farmers housing all their gestating sows individually and having no plans to convert to group housing within 2 yr were asked to allocate 100 points according to the relative importance of various reasons for having no intentions yet to change to a group housing system. The questionnaire was identical for the entire duration of the study with the exception that some additional questions were inserted in the more recent surveys for farmers housing gestating sows in group and for farmers planning to convert to group housing. Both types of farmers were additionally asked to indicate whether an existing barn was altered to conform to group housing (renovated) or a new unit was built (from the 2005 survey onwards), and whether the gilts and sows are kept separately (2009 survey only). The 2009 survey asked farmers using group housing about the average number of days after service that sows are (re-) introduced into the group and about the average number of days before expected farrowing date that the sows are removed from the group into the farrowing crates.

The results were analyzed using SAS 9.2 (SAS Inst. Inc., Cary, NC) for windows. Descriptive statistics were used mainly. Binary variables were analyzed using a logistic regression model (Proc Logistic). Continuous variables were analyzed using a linear model (Proc Mixed). Statistical significance was evaluated at $P = 0.05$. For the comparisons between the different types of group housing, all possible pair-wise comparisons were tested at a total

significance level of 0.05 using the Tukey-Kramer adjustment for multiple comparisons. To determine 4 different types of non-converting farmers, a cluster analysis (Proc fastclus) was performed on the variables explaining the reason for not converting. These clusters were used for further analyses. Due to the small sample size, data from 2003 to 2009 were merged into 1 dataset for most analyses. The effect of sample year was analyzed when appropriate.

RESULTS

General Description of Respondents: Evolution 2003 - 2009

With only 2.9% of the total sample refusing to participate with the survey, the overall response rate was very high (although decreasing slightly from 2003 to 2009; Table 2). Combined with the random selection of the sample, we feel confident that the respondents were representative of Flemish pig producers.

The overall proportion of farrow to finish farms (as opposed to breeding herds only) fluctuated between 61% and 75% during the different survey years (Table 3). During the 4 surveys, the reported likelihood of a successor for the farm was slightly below the neutral point of the scale (score 3). The respondents were on average 46.5 yr of age (range: 18 to 85), and this did not vary between the years that the survey was conducted ($P > 0.5$). The mean herd size increased from 116 sows in 2003 to 152 sows in 2009 ($F = 13.21$, $P < 0.001$). In all survey years, the vast majority of respondents had between 50 and 200 sows, but from 2003 to 2009 farms with a very small sow herd size ($\leq$ 20 sows) decreased and farms with a very large sow herd size (> 300 sows) increased (Figure 1). Sow herd size was larger when the farmer was young ($F =$

13.21, $P < 0.001$), when there was likely to be a successor for the farm ($F = 62.67$, $P < 0.001$), and for breeding herds instead of farrow to finish farms ($F = 4.92$, $P = 0.027$). A successor was more likely for farrow to finish herds ($F = 3.27$, $P = 0.001$).

Farms with Group Housing Systems

General Description and Evolution 2003 to 2009. The percentage of respondents housing their gestating sows in a group, rose from 10.5% in 2003 to 29.8% in 2007 (Figure 2). Surprisingly, in 2009 this percentage had dropped again to 24.6%. The larger the sow herd ($\chi_1^2 = 15.6$, $P < 0.001$) and greater the likelihood of a successor ($\chi_1^2 = 4.2$, $P = 0.04$), the greater the likelihood that sows are housed in a group (see also Table 3). The type of farm (farrow to finish versus breeding herd) and the age of the farmer did not differ significantly between farms with vs. without a group housing system ($P > 0.35$). The estimated proportion of sows that were kept in a group during gestation; however, continued to rise from 9.1% in 2003 to 34.1% in 2009 (Figure 2). On farms with group housing, on average 77%, 74%, 83% and 84% of the sows were housed in a group during gestation in 2003, 2005, 2007 and 2009, respectively.

Combining data from 2003 until 2009, 48% of the group housing systems were in renovated houses, 41% used dynamic groups, 25% used straw, and 31% used a 3-wk production system. On average there were 24 sows in a group. The mean floor space allowance was 2.5 m² per sow (Table 4), but this decreased with the age of the system ($F = 10.94$, $P = 0.001$). The mean age of the systems decreased from 13 yr in 2005 to 6 yr in 2009 ($F = 15.4$, $P < 0.001$, Table 4). Environmental enrichment was provided on 30% of the farms with group housing. This percentage was greater in 2007 than 2005 (Table 4). In 2009 sows were brought into the group on average 28.3 d (SE = 1.7) after service until 7 d (SE = 0.4) before expected date of farrowing,

and gilts were kept separate from the other sows on 62% of the farms with group housing. As mentioned above, no data about the latter 2 aspects were collected during the earlier surveys.

Different Types of Group Housing Systems. The most common type of group housing systems in Flanders during 2003 to 2009 were free access stalls (31%), followed by feeding stalls/troughs with manual feed delivery (20%), ad libitum feeding systems (18%), electronic feeding stations (16%), and drop feeding (10%). Interval feeding and electronic feed dispensers were very rare (Table 5). A somewhat different picture emerges if popularity of the different systems is expressed at the level of the sow instead of the farm. For example, whereas 20% of the farms with group housing used manual feeding stalls/troughs, only 7% of the group-housed sows were housed in this system (Table 5).

There were some differences in farm type and management according to the group housing system used (Table 6). Feeding stalls/troughs with manual feed delivery were the oldest system used by older farmers with small sow herds, while interval feed dispensers were the youngest system used by younger farmers. The mean group size was larger for electronic feed dispensers and electronic feeding stations compared to the others feeding systems. With feeding stalls/troughs, a 3-wk management system was used less often than with drop feeding or interval feed dispensers. On farms with electronic feeding stations sows were more likely to be kept in dynamic groups than in the other group housing systems with the exception of electronic feed dispensers.

Reasons for Choosing a Certain Type of Group Housing System. The main criteria for having chosen a particular type of group housing system were related to the investment costs and

208 the health and welfare of the sows (Figure 3). The more recent the group housing system was,
209 the greater the relative influence of economical reasons ($F = 7.45$, $P = 0.007$) and of the type of
210 labor ($F = 4.15$, $P = 0.043$).
211
212 ***User Satisfaction.*** On average, farmers using a group housing system reported to be
213 rather satisfied with their system both in general and specific for 8 criteria (Table 7). Overall
214 satisfaction was lowest among users of electronic feed dispensers but did not differ between
215 users of the other systems (Table 7). Farmers using group housing for all sows were generally
216 more satisfied than farmers using both group housing and individual stalls ($F = 12.55$, $P <$
217 0.001). Farmers providing no environmental enrichment were also more satisfied than farmers
218 providing environmental enrichment ($F = 3.67$, $P = 0.057$). User satisfaction also increased with
219 the number of years the system had been operational ($t = 2.55$, $P = 0.012$). Users of electronic
220 feed dispensers were in general significantly less content as compared to users of the other group
221 housing systems, with exception of interval feed dispensers.
222 Satisfaction scores for mechanics/electronics, running costs and ease of use were highly
223 correlated and therefore grouped. For users of older systems ($t = 2.23$, $P = 0.027$) and when all
224 sows on the farm are housed in groups ($t = 2.26$, $P = 0.025$), this combined score was higher. It
225 was lowest for users of electronic feed dispensers, followed by electronic feeding stations (Table
226 7). Similarly, scores for sow health, welfare and performance were highly correlated and
227 therefore grouped as well. This combined score was distinctly lower for electronic feed
228 dispensers as compared to the other group housing systems (Table 7). It was also lower for more
229 recent housing systems ($t = 2.72$, $P = 0.007$), when not all sows on the farm are housed in group

230 (t = 3.71, P < 0.001), when environmental enrichment is provided (t = -3.02, P = 0.003), and the
231 smaller the group size (t = 2.08, P = 0.040).
232
233 ***Individual Sow Housing Systems***
234 ***Reasons for not Planning to Change to Group Housing within 2 yr.*** The vast majority
235 of farmers with only individual sow housing had no plans yet to convert to a group housing
236 system within the next 2 yr (> 90% in all years). Some of the reasons why these farmers were
237 not planning to change to a group housing system changed with time (Table 8). In 2003 and 2005
238 the main reason was that the enterprise would be stopped before 2013 when group housing
239 becomes compulsory, whereas in 2007 and 2009 the most important reason concerned the
240 uncertainty about the future of the farm (Table 8). Uncertainty about future legislation was also
241 more important in 2003 and 2005 than later.
242 Cluster analysis revealed that 4 groups of farmers could be differentiated according to the
243 relative importance of the different reasons for not planning a conversion to group housing. For
244 type 1 farmers, the end of their farming activities before 2013 was the main reason for not
245 converting to group housing. For type 2 farmers, the main reason for not planning to convert to
246 group housing was that the mortgage of the current pig unit had not yet been paid off and the
247 lack of finances. The majority of the farmers belonged to type 3. Their main motivations were
248 maximal delaying of converting to group housing and the uncertainty of future legislation.
249 Finally, there was a small group of type-4 farmers who reported that the lack of information
250 concerning the legislation and different types of group housing systems as an important reason
251 for not converting to group housing. The percentage of type 1 and 2 farmers decreased from
252 2003 up to 2007, whereas the proportion of type 3 farmers increased (Table 9). Type 1 farmers

253 tended to be the oldest, to be the least likely to have a successor, and to have the smallest sow
254 herd, whereas type 2 farmers tended to be the youngest, to be the most likely to have a successor
255 and to have the largest sow herd.
256
257 ***Change to Group Housing Planned within 2 yr.*** The percentage of farmers planning to
258 convert from an individual to a group housing system did not tend to increase after 2005 (Figure
259 2). The likelihood of having detailed plans to convert to group housing within a period of 2 yr
260 increased with the number of sows on the farm (χ_1^2 = 11.73, P < 0.001) and with the likelihood
261 of having a successor (χ_1^2 = 4.71, P = 0.030), but decreased with the age of the farmer (χ_1^2 =
262 7.52, P = 0.006). More than half of these farmers reported that they will convert to a group
263 housing system with free access stalls (Table 5). The second most popular system that is planned
264 to be built is ad libitum feeding (11.5%) when expressed as the percentage of farms, but interval
265 feed dispensers (16%) when expressed as the percentage of sows (Table 5).
266 As was the case for those already using group housing systems, the main criteria for
267 choosing a particular group housing system related to the investment costs, the health and
268 welfare of the sows (Figure 3). However, sow performance (t = -2.68, P = 0.009) and proven
269 quality of the system (t = -2.20, P = 0.029) were given more importance, whereas the running
270 costs (t = 2.91, P = 0.004) were assigned less importance by farmers planning to convert in the
271 future as compared to farmers that have converted already. The investment cost was given more
272 importance by farmers planning to install an ad libitum feeding system as compared with those
273 planning to install free access stalls (t = -3.17, P = 0.038).
274

DISCUSSION

The change from individual to group housing of gestating sows occurs very slowly in Flanders, and by extension also in Belgium. The percentage of farmers with group housing for all or some of the gestating sows increased from 2003 to 2007, but then decreased again by 2009. Three quarters of the pig producers will have to either stop keeping sows or change to group housing between 2009 and 2013 in order to comply with the EU ban on individual gestation stalls. In fact, the percentage of farms that fully complies with the new EU legislation is considerably smaller, as many farms have group housing for only a part of the gestating sows, and because many of the group housing systems do not meet other norms, such as stocking density or light intensity (Geverink et al., 2008).

As only 7% of the pig farmers were planning to change to group housing by 2011, it seems that the majority of the farmers who wish to continue farming is delaying to convert until the last 2 yr before the ban. We therefore intend to continue monitoring the change to group housing systems in Flanders during the coming years. Indeed, the majority of the farmers indicated that maximum delay and uncertainty about the future are the main reasons for not having planned to change already. A similar tendency was reported for the Netherlands, where 66% of the pig producers who still housed their gestating sows individually in 2008 planned to delay the change to group housing until the very last year before the ban (Hoste and van der Peet-Schwering, 2008). The proportion of farmers that will stop their career before the ban diminishes as the deadline of 2013 approaches. This is also reflected in the present study by the reduced importance given to this reason in 2007 and 2009 as compared to 2003 and 2005. It is not surprising that the farmers who housed sows in groups already or who were planning to

298 change to group housing within 2 yr were more likely to have a successor and had a bigger sow
299 herd as compared to farmers with individual housing.
300 This difference in herd size between farms with group housing versus without increased
301 from 2003 until 2009 (from a 3.4% difference to 87.1%, respectively). This explains why the
302 change to group housing was faster when expressed at the level of the sow instead of the farm,
303 particularly when combined with the trend that farms with group housing increased the
304 proportion of the sow herd that was housed in group during gestation.
305 Between 2007 and 2009 the change to group housing seems to have slowed down when
306 expressed at the level of the sow, or was even reversed when expressed at the level of the farm.
307 A possible explanation for this unexpected reduction of the proportion of farms with group
308 housing, is that during this period – which has been said to be a harsh period for pig production
309 (Deuninck et al., 2009) – very few new farmers converted to group housing whereas farmers
310 with older, first-generation, mostly group housing systems quit farming. The sudden drop in the
311 mean age of the group housing systems from 12 to 13 yr in 2003 and 2005 to 6 to 7 yr in 2007
312 and 2009 gives some support to this hypothesis.
313 With only 25% of the farmers keeping some or all of their gestating sows in group in
314 2009 and another 7% planning to convert to group housing within 2 yr, it can be tentatively
315 predicted that 68.5% of the pig producers will still house all their gestating sows individually by
316 2011 (assuming that farmers with individual housing are not more likely to stop farming sows
317 than farmers with group housing systems). It is clear that the Belgian pig industry has a long way
318 to go in order to meet the 2013 deadline and that the pig industry is expected to undergo rapid
319 and drastic changes during 2011 and 2013. Historically, though, sows have been usually kept in
320 groups (Maton et al., 1985). Since the 1960s, however, these group housing systems have been

321 extensively replaced in Belgium – just like in other regions with intensive pig production – by
322 individual gestation stalls, which reduce aggressive encounters even at high stocking density, and
323 allow easy management, controlled feed intake and individual monitoring of health and stage of
324 pregnancy (Daelemans, 1998). In some European countries such as Sweden, Switzerland and the
325 UK, group housing systems became relatively common again since the 1990s as controversy
326 about housing pregnant pigs in individual stalls increased (Bartussek et al., 2000). In other
327 countries, however, individual stalls continued to be the standard housing system for gestating
328 sows. In some of these latter countries, of which Belgium is an example in place, the transition
329 occurs much more slowly and it appears that compliance with the EU ban on individual housing
330 by 2013 will be a considerable challenge. The socio-economic consequences of the EU ban for
331 the Belgian pork industry may be far-reaching, especially if the economic situation of the pig
332 farmers will not allow new investments during the few years remaining before the deadline of
333 2013.

334 For many other EU countries, data about the change to group housing are not readily
335 available, but the situation may be equally worrying for some. On average, though, European
336 countries have already made more progress in this transition process (Hendriks et al., 1998; Hoy,
337 2001). In the Netherlands, for example, 56% of the farms had converted to group housing by
338 2008 (Hoste and van der Peet-Schwering, 2008). The percentage of farms with group housing is
339 also higher in many other countries with intensive pig production outside Europe such as the
340 USA (30-40%: Barnett et al., 2001; USDA, 2001), New-Zealand (50%: Gregory and Devine,
341 1999), and Australia (37%: Patterson et al., 1997).

342 Combined data from all 4 surveys between 2003 and 2009 indicated that the most
343 common type of group housing system in Flanders were free access stalls, followed by feeding

344 stalls/troughs with manual feed delivery, ad libitum feeding systems, electronic feeding stations,
345 and drop feeding, whereas interval feeding and electronic feed dispensers were very rare. The
346 popularity of free access stalls is even greater when expressed at the level of the sow instead of
347 the farm, and is expected to rise even further in the future (54% of the farmers planning to
348 convert to group housing had opted for this system). In the Netherlands, this proportion was even
349 greater: 71% of the farmers who already knew to which type of group housing system they
350 would convert to between 2008 and 2013 had opted for free access stalls (Hoste and van der
351 Peet-Schwering, 2008). In contrast with the free access stalls, the share of feeding stalls/troughs
352 with manual feed delivery in the present study was much smaller when expressed at the level of
353 the sow as these occur predominantly on farms with a small sow herd. Manual feeding systems
354 are expected to decline in the future because it is used often by older farmers and very few
355 farmers planning to convert to group housing choose this “old-fashioned” system. Electronic
356 feeding stations are also expected to become less common in the future, just as is predicted in the
357 Netherlands (Hoste and van der Peet-Schwering, 2008). According to van der Peet-Schwering et
358 al. (2010) this system requires more labor and superior stockmanship skills as compared to other
359 group housing systems and free access stalls in particular. On the other hand, they gave free
360 access stalls the lowest score for verifiability and acceptance by society.
361 The hands-on experience of farmers who have been keeping sows in group is valuable to
362 farmers who still have to convert. Very few farmers reported dissatisfaction with the group
363 housing system they are using. In a recent on-farm observational study in the Netherlands sow
364 reproduction, welfare and condition parameters were not influenced by the system of group
365 housing (feeding station with straw, feeding station without straw, free access stalls, trough
366 feeding) (van der Peet-Schwering et al., 2009). The authors concluded that with each of these

367 systems adequate results can be achieved. This agrees with the few differences in satisfaction
368 between users of the different group housing systems found in the present study. The main
369 exception is the more negative evaluation by users of electronic feed dispensers. However, the
370 latter finding should be treated with caution as it is based on only 5 respondents. Another
371 exception is that users of electronic feeding stations indicated lower satisfaction for the
372 combined score for ease of use, running costs and the mechanics/electronics than users of most
373 other group housing systems. Concerning other aspects and general satisfaction, however, the
374 scores for electronic feeding stations were comparable to that of other systems. User satisfaction
375 was greater when the housing system had been operational for a longer time. This illustrates
376 perhaps that group housing systems require better or at least different management and
377 stockmanship skills, e.g. to prevent problems associated with aggression, competition and
378 impaired reproduction (Arey and Edwards, 1998; McGlone et al., 2004; Jansen et al., 2007;
379 Kongsted et al., 2007; Strawford and Gonyou, 2008; Spoolder et al., 2009). Farmers who
380 converted earlier may also have a more favorable attitude towards group housing than farmers
381 who converted recently. Intriguingly, there was also a trend to greater user satisfaction when
382 farmers did not provide environmental enrichment. Although the data did not allow us to
383 substantiate this, it is possible that environmental enrichment was more likely to be provided in
384 response to problems such as aggression between sows. Another possibility is that the extra labor
385 or cost of the enrichment contributed to a lower satisfaction. The greater satisfaction among
386 farmers using group housing for all their gestating sows compared to those using both individual
387 and group housing could be related to a greater commitment to, and focus on, the new system as
388 has been hypothesized previously (Tuyttens et al., 2008).

As group housing requires appropriate stockmanship skills and as the pig farmer management is more determining for success than the group housing system (van der Peet-Schwering et al., 2009), it is not inconceivable that the attitude of pig producers influences the extent to which the ban on individual stalls will result in the hoped-for improvement in sow welfare in practice. In this respect, it is important for policy makers as well as researchers to know the underlying reasons why other farmers are not yet planning to change and which criteria farmers consider important in choosing a group housing system. In the present study, the investment cost, followed by concerns for the health and welfare of the sows, were reported to be the most important reasons for having chosen a particular type of group housing system. With the exception of the relatively cheap ad libitum and electronic sow feeders (with straw bedding), differences in investment costs that are inherent to the type of group housing system appear limited though (Vermeer et al., 2001). These authors reported that variation in investment costs appear to be related mainly to differences in the starting position of the barn in the case of renovation, or in the level of finish and workmanship in the case of newly built units. Moreover, the cheapest systems in terms of investment costs may be expensive in the long run (high operating costs / low sow performance / increased labor) or require superior stockmanship skills. The current study revealed that the relative importance of economical aspects and type of labor was higher among Flemish pig producers who had recently converted to group housing. Given the increasing competition in the pig industry, there may be less room for other aspects to influence the choice of group housing system. The recommendation that pig producers should choose a system that suits them and their herd (Vermeer et al., 2001; Gonyou, 2003; van der Peet-Schwering et al., 2010) may be incompatible with the increasing one-sided focus on economical aspects.

We conclude that with only 25% of the farmers keeping (some of) their gestating sows in group in 2009 and another 7% planning to convert before 2011, the change to group housing systems is taking place more slowly in Belgium as compared to many other regions with intensive pig production both inside and outside the EU. Many farmers will stop keeping sows before the deadline of 2013, thereby possibly creating opportunities for others to increase their sow herd. Others postpone the conversion as long as possible. This implies that the Belgian pig production is likely to undergo tremendous changes during the coming years. We suspect that the situation may be equally acute in some other EU countries. It also implies perhaps that a considerable proportion of pig producers will be forced to convert without believing that the advantages of group housing outweigh the disadvantages (or that the advantages benefit mainly other stakeholders while the producers bear most disadvantages). Indirectly, the increasing popularity of free access stalls compared to other group housing systems seems to give some support to this speculation. The farmers' preference for this group housing system cannot be explained by a lower investment cost (which conflicts with the increasing importance farmers allocate to this criterion), nor by clearly superior scores with regard to user satisfaction (specific to this study) or on-farm evaluations (van der Peet-Schwering et al., 2009). Moreover, reportedly this system poorly meets societal expectations (van der Peet-Schwering et al., 2010), and in theory it is possible to permanently lock up the sows in the stalls, which makes it hard for inspection officers to verify whether the sows are truly housed in group. The popularity of this system, and particularly among pig producers who delay converting to group housing for as long as possible, might rather be related to the close resemblance of this housing system with the familiar individual gestating stalls and to the easier management without requiring too many additional stockmanship skills. Therefore, we recommend that both policy and research in future

435 also take into consideration the likely effect of farmer attitude on the success – in terms of the
436 welfare of both the farmer and the sow – of (different) group housing systems in practice.

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Table 1. Classification of 7 group housing systems currently used for sows in Belgium based on 5 criteria [1]

Type of group-housing system	Physical separation during feeding	Individualized ration	All sows can eat simultaneously	Feed restriction	Automated feed delivery
Drop/Trickle feeding (DROP)	partial (no)	no	yes	yes	yes
Electronic feeding station (EFS)	complete	yes	no	yes	yes
Free access stalls (FAS)	complete	no	yes	yes	no/yes
Ad libitum feeding (AdL)	no	no	no	no	no/yes
Electronic feed dispensers (EFD)	no	yes	no	yes	yes
Interval feed dispensers (IFD)	no	no	no	yes	yes
Manual feeding stall/trough (MAN)	partial/no	no	yes	yes	no

[1] See Tuyttens et al. (2008) and references therein for a description of these criteria and housing systems.

519 **Table 2.** Response rate to the total number of questionnaires sent to Flemish sow keepers in the
520 biannual surveys (2003 to 2009)
521

	2003	2005	2007	2009
No. questionnaires sent	250	352	302	300
No. of faulty addresses	0	6	4	3
No. that had quit keeping sows	30	38	48	57
No. that could not be contacted	1	7	13	15
No. who refused to participate	0	4	9	22
No. of valid respondents	219	297	228	203

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525 **Table 3.** Comparison between 3 types of pig producers: (1) those that use an individual housing
526 system and have no plans to convert to group housing within 2 yr, (2) those that use an
527 individual housing system but have plans to convert to group housing within 2 yr, and (3) those
528 that use a group housing system
529

	Individual housing[1]			
	No converting plans	converting plans	Group housing[1]	Total[1]
2003				
Number of farmers	187	9	23	219
Mean age farmer	47.6 (0.8)	40.3 (2.5)	46.5 (2.3)	47.2 (0.7)
Likelihood successor[2]	2.6 (0.1)	2.9 (0.1)	3.1 (0.2)	2.7 (0.1)
Mean no. of sows	112.1 (6.0)	193.9 (40.3)	116.0 (12.9)	115.9 (5.6)
% farrow to finish farms	61.5	55.6	60.9	61.2
2005				
Number of farmers	227	22	48	297
Mean age farmer	47.4 (0.7)	40.6 (1.5)	45.8 (1.5)	46.6 (0.6)
Likelihood successor[2]	2.6 (0.1)	2.8 (0.1)	2.9 (0.2)	2.7 (0.1)
Mean no. of sows	116.1 (6.0)	181.0 (20.6)	142.1 (16.9)	125.1 (5.7)
% farrow to finish farms	70.9	81.8	66.7	70.7
2007				
Number of farmers	145	15	68	228
Mean age farmer	46.3 (0.8)	47.0 (2.5)	45.2 (1.1)	46.0 (0.6)
Likelihood successor[2]	2.7 (0.1)	3.2 (0.2)	2.8 (0.1)	2.8 (0.1)
Mean no. of sows	122.6 (9.0)	157.7 (20.8)	174.6 (17.6)	140.3 (8.0)
% farrow to finish farms	72	92.9	76.9	74.8
2009				
Number of farmers	139	14	50	203
Mean age farmer	47.4 (0.8)	42.6 (2.0)	43.8 (1.2)	46.2 (0.7)

Likelihood successor[2]	2.4 (0.1)	3.2 (0.3)	2.78 (0.2)	2.5 (0.1)
Mean no. of sows	126.2 (6.8)	199.6 (25.7)	236.1 (36.1)	151.8 (10.7)
% farrow to finish farms	63.3	78.6	60.0	63.5

530

531 [1] The values are the means (SE) or the percentages.

532 [2]Scored on a scale from 1 (very unlikely) to 5 (very likely)

533

534 **Table 4.** Characteristics of Flemish group housing systems for gestating sows between 2003 and

535 2009

	2003[1]	2005[1]	2007[1]	2009[1]	Total[1]
Mean age system, yr	12.3 (2.0)ab	12.8 (1.4)a	7.0 (1.2)[bc]	5.6 (1.4)[c]	8.8 (0.7)
Mean group size	18.6 (3.3)	23.6 (3.8)	23.1 (3.8)	26.2 (4.4)	23.5 (2.1)
Providing enrichment, %	8.7[ab]	14.6[a]	41.5[b]	39.6[ab]	29.9

536

537 [a,b,c]Within a row, means without a common superscript differ ($P < 0.05$)

538 [1]The values are the estimated means (SE) or the percentages.

539

Table 5. Comparison of the occurrence (expressed as % of the farms and as estimated % of the gestating sows housed in group) of the 7 group housing systems for gestating sows used and planned to be built in a time-span of 2 yr from 2003 until 2009

		Type of group housing system[1]							
		DROP	EFS	FAS	AdL	EFD	IFD	MAN	n
In use:									
2003	farms	17.4	26.1	34.8	17.4	0.0	0.0	4.4	23
	sows	17.7	30.9	23.8	27.2	0.0	0.0	0.4	2,318
2005	farms	10.4	18.8	18.8	20.8	0.0	6.3	25.0	48
	sows	9.3	17.0	27.4	29.5	0.0	9.2	7.5	5,628
2007	farms	13.2	11.8	27.9	14.7	5.9	2.9	23.5	68
	sows	11.5	9.6	25.8	22.2	14.1	6.3	10.5	10,135
2009	farms	2.0	14.0	44.0	18.0	2.0	4.0	16.0	50
	sows	2.2	13.4	55.8	20.9	1.5	1.5	4.6	10,985
All years	farms	10.1	15.9	30.7	17.5	2.6	3.7	19.6	189
	sows	8.1	14.2	37.3	23.5	5.5	4.6	6.9	29,066
Planned to be built within 2 yr:									
2003	farms	22.2	11.1	33.3	11.1	0.0	22.2	0.0	9
	sows	15.5	16.0	22.6	6.9	0.0	39.0	0.0	1,745
2005	farms	8.7	4.4	65.2	13.0	0.0	8.7	0.0	23
	sows	7.4	8.6	63.0	9.7	0.0	11.3	0.0	2,802
2007	farms	6.7	6.7	53.3	6.7	0.0	0.0	26.7	15
	sows	0.9	3.4	64.1	8.5	0.0	0.0	23.3	2,365
2009	farms	7.1	7.1	50.0	14.3	14.3	7.1	0.0	14
	sows	3.1	8.3	38.3	15.1	16.6	18.7	0.0	2,414
All years	farms	9.8	6.6	54.1	11.5	3.3	8.2	6.6	61
	sows	6.1	8.6	49.3	10.3	4.3	15.5	5.9	9,326

[1] See Table 1 for abbreviation description

547 **Table 6.** Comparison between the 7 group housing systems for gestating sows (2003 to 2009

548 survey data combined)

	Type of group housing system[1,2]							
	DROP	EFS	FAS	AdL	EFD	IFD	MAN	All types
Mean age of farmer, yr	42 (2) [a]	44 (2) [a]	45 (1) [a]	45 (2) [ab]	38 (4) [a]	38 (3) [a]	51 (1) [b]	45.1 (0.7)
Mean age of system, yr	6.1 (2.2)[a]	12.8 (1.7)[ab]	6.7 (1.3)[a]	6.4 (1.7)[a]	7.2 (4.3)[ab]	2.6 (3.6)[ab]	14.4 (1.7) [b]	8.8 (0.7)
Mean no. of sows in herd	154 (38)[ab]	148 (30)[ab]	203 (22)[a]	234 (29)[a]	318 (74)[a]	270 (62)[ab]	78 (27)[b]	176 (12)
Mean group size	11 (5)[a]	50 (4)[b]	15 (3)[a]	26 (4)[a]	87 (10) [c]	11 (9)[a]	13 (4)[a]	24 (2)
Dynamic groups, %	10.5[a]	93.3[b]	32.8[a]	38.7[a]	80.0[ab]	14.3[a]	25.7[a]	40.5
Using a 3-wk system, %	63.2[a]	36.7[ab]	25.9[ab]	24.2[ab]	40.0[ab]	85.7[a]	13.5[b]	31.2

549

550 [a,b,c]Within a row, means without a common superscript differ ($P < 0.05$)

551 [1]See Table 1 for abbreviation description

552 [2]The values are the estimated means (SE) or the percentages.

553

554 **Table 7.** Satisfaction scores on 8 criteria separately and combined as reported by the users of the 7

555 different group housing systems for gestating sows (2003 to 2009 survey data)

	Type of group housing system[1,2]					
Criterion	DROP	EFS	FAS	AdL	EFD	IFD
1.Labor (amount)	3.8 (0.7)	3.4 (0.6)	4.4 (0.4)	4.1 (0.5)	2.4 (1.4)	4.3 (1
2.Labor (type)	3.7 (0.2)	3.5 (0.2)	3.7 (0.1)	3.8 (0.2)	2.6 (0.4)	4.0 (0
3.Mechanics/ electronical	4.3 (0.2)^{ab}	3.5 (0.3)^{a}	4.1 (0.2)^{ab}	4.6 (0.2)^{b}	4.0 (0.6)^{ab}	4.8 (0.
4.Running costs	4.2 (0.2)^{a}	3.3 (0.2)^{b}	3.7 (0.1)^{ab}	4.0 (0.2)^{a}	3.2 (0.4)^{ab}	4.0 (0.
5.Ease of use	4.1 (0.2)^{ac}	3.2 (0.2)^{ab}	3.8 (0.1)^{a}	4.5 (0.2)^{c}	2.4 (0.4)^{b}	4.3 (0.
6.Sow welfare	3.7 (0.3)^{a}	3.9 (0.2)^{a}	3.9 (0.1)^{a}	4.2 (0.2)^{a}	1.8 (0.5)^{b}	3.9 (0
7.Sow health	3.8 (0.2)^{a}	4.0 (0.2)^{a}	3.9 (0.1)^{a}	4.1 (0.2)^{a}	2.2 (0.4)^{b}	3.6 (0.
8.Zootechnical performance	3.8 (0.2)	3.8 (0.2)	3.7 (0.1)	3.8 (0.2)	2.6 (0.4)	3.7(0
Mean 3-5[3]	4.2 (0.2)^{a}	3.3 (0.1)^{b}	3.9 (0.1)^{ac}	4.3 (0.2)^{a}	2.8 (0.4)^{bc}	4.3 (0.
Mean 6-8[4]	4.1 (0.2)^{a}	3.7 (0.2)^{a}	3.9 (0.1)^{a}	4.1 (0.2)^{a}	1.9 (0.4)^{b}	4.0(0.
General[5]	3.9 (0.2)^{a}	3.8 (0.1)^{a}	3.9 (0.1)^{a}	4.1 (0.1)^{a}	2.4 (0.4)^{b}	3.7 (0.

556
557 [a,b,c]Within a row, means without a common superscript differ ($P < 0.05$)

558 [1] See Table 1 for abbreviation description

559 [2]The values are estimated mean scores (SE) on a scale from 1 (not at all satisfied) to 5 (very

560 satisfied)

561 [3]Criteria 3-5 are strongly correlated

562 [4]Criteria 6-8 are strongly correlated

563 [5]General satisfaction as scored on a 1 – 5 scale by the respondents

564

Table 8. Relative importance scores of 13 different reasons for not yet planning to change to a group housing system for gestating sows within 2 yr as reported by Flemish pig farmers in the 2003 - 2009 surveys

		2003[1]	2005[1]	2007[1]	2009[1]
1.	Mortgage current stables not expiring in near future	12.0 (1.6)	10.1 (1.4)	7.8 (1.8)	7.6 (1.8)
2.	Insufficient financial resources	7.4 (1.2)	8.1 (1.1)	5.9 (1.4)	11.0 (1.4)
3.	Uncertainty about the future of the farm	11.1 (1.9)[a]	11.5 (1.7)[a]	28.9 (2.2)[b]	15.6 (2.2)[a]
4.	Uncertainty about future legislation	10.7 (1.2)[a]	8.3 (1.5)[ac]	3.3 (1.7)[b]	5.8 (1.2)[bc]
5.	Individual housing is financially more optimal	7.1 (1.0)	6.7 (0.9)	4.2 (1.1)	5.1 (1.1)
6.	Delaying change to group housing is most profitable	9.5 (1.3)	9.3 (1.2)	6.3 (1.5)	10.3 (1.5)
7.	Not ready yet to consider group housing	8.7 (1.5)[a]	15.4 (1.3)[b]	8.6 (1.7)[a]	11.4 (1.8)[ab]
8.	End of career, quit business before 2013	21.3 (2.4)[a]	18.3 (2.2)[ac]	8.1 (2.8)[bc]	9.8 (2.8)[c]
9.	Farm will be taken over by someone else before 2013	4.3 (1.1)	2.6 (1.0)	2.6 (1.2)	4.8 (1.2)
10.	Insufficient information about current legislation	1.8 (0.4)	1.5 (0.4)	1.9 (0.5)	1.9 (0.5)
11.	Insufficient information about group housing systems	4.1 (0.9)	3.2 (0.8)	3.5 (1.0)	4.9 (1.0)
12.	Don't know about a ban on individual confinement	0.7 (0.4)	0.6 (0.4)	0.9 (0.5)	0.4 (0.3)
13.	Other	0.8 (1.6)[a]	3.2 (1.4)[a]	18.0 (1.8)[b]	11.2 (1.9)[c]

[a,b,c]Within a row, means without a common superscript differ ($P < 0.05$)

[1]The values are the estimated mean scores (SE) on a 0 to 100 scale (respondents divided 100 points among the 13 reasons with more points indicating greater relative importance)

574 **Table 9.** Distribution (% of farmers) of 4 types of Flemish pig producers clustered according to
575 their reported reasons for not yet planning to change to a group housing system for their
576 gestating sows in the 2003 to 2009 surveys

Cluster	2003	2005	2007	2009
1: End of career	23.0	18.5	7.6	10.8
2: Mortgage	18.7	15.4	9.0	10.8
3: Max. delay & uncertain future	55.6	63.9	80.6	74.8
4: Lack of information	2.7	2.2	2.8	3.6

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Figure 2. Evolution between 2003 and 2009 of the distribution of sow herd size on Flemish pig farms.

Figure 2. Evolution between 2003 and 2009 of the percentage of farms with group housing (GH farms), the estimated percentage of sows that are housed in group during most of gestation (GH sows), the percentage of farms where a conversion to group housing is planned within 2 yr (GH farms planned), and the estimated percentage of sows for which a conversion to group housing is planned within 2 yr (GH sows planned).

Figure 3. The relative importance of various reasons for having chosen a specific group housing system as reported by farmers using such a system already (GH in use) or planning to build one within 2 yr (GH planned). The estimated mean scores (SE) are given on a 0 to 100 scale (respondents divided 100 points among the different reasons with more points indicating greater relative importance). Survey data from 2003 to 2009 are combined. * denotes that the importance for that reason differed significantly ($P < 0.05$) between GH in use and GH planned.

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607 **Figure 1.**

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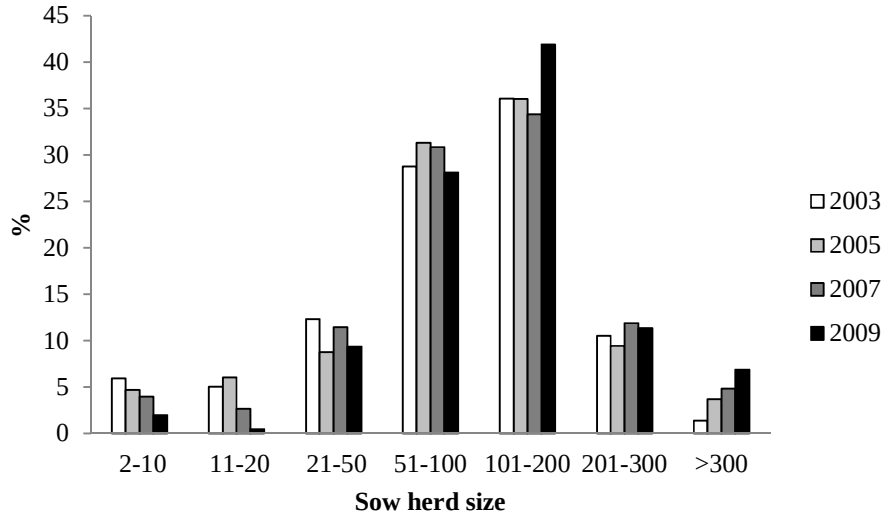

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614 **Figure 2.**

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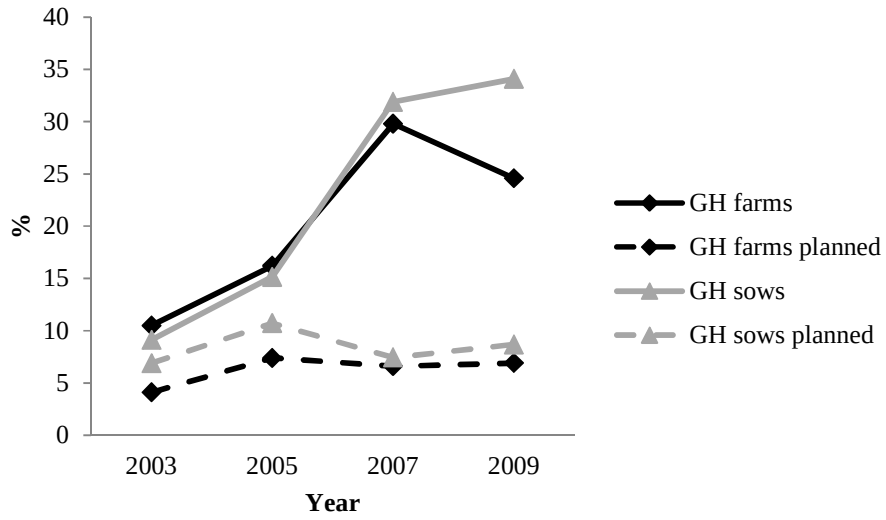

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622 **Figure 3.**

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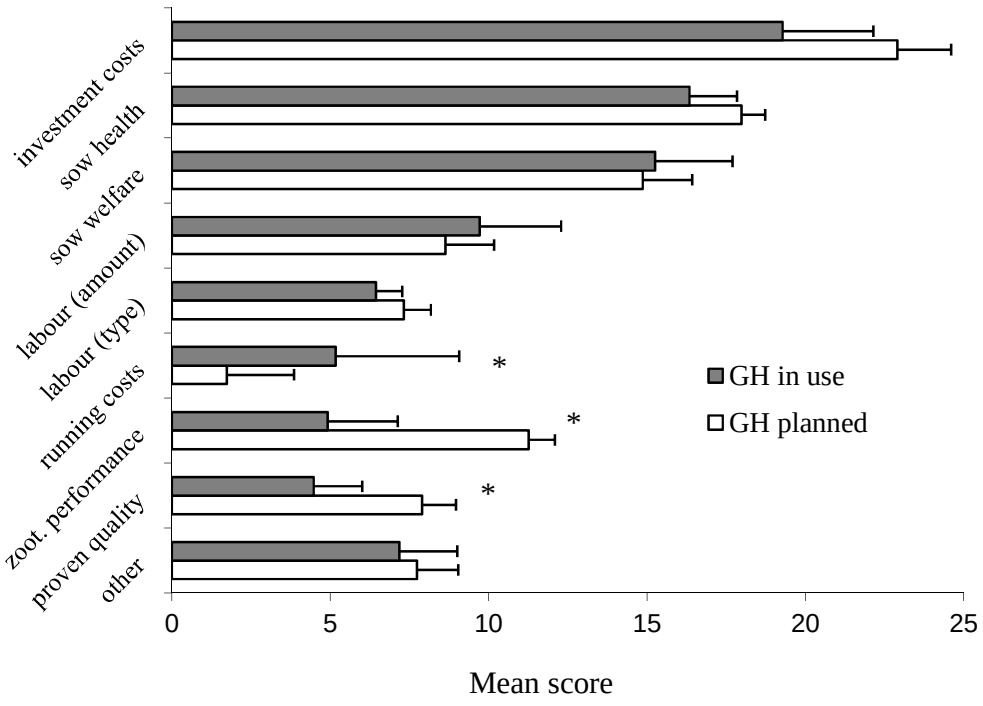

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